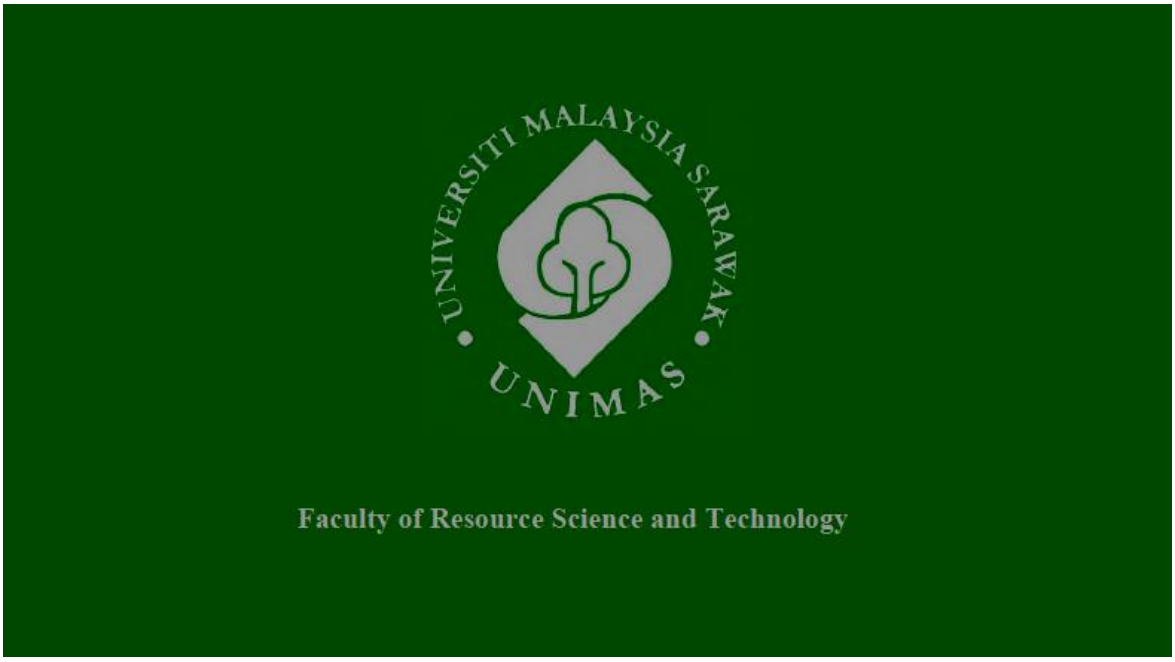

THE EFFECT OF SEED MATURITY ON GERMINATION AND SUBSEQUENT SEEDLING GROWTH OF *PONGAMIA PINNATA* (L.)

AJEERAH FIRDAUSUL TITING

Bachelor Science with honours
(Plant Resource Science and Management)
2015

UNIVERSITI MALAYSIA SARAWAK

Grade: _____

Please tick (√)

Final Year Project Report ☒

Masters ☐

PhD ☐

DECLARATION OF ORIGINAL WORK

This declaration is made on the 25 day of 06 year 2015

Student's Declaration:

I AJEERAH FIRDAUSUL TITING (35390) FROM ~~FACULTY OF RESOURCE~~ FSTS

(PLEASE INDICATE NAME, MATRIC NO. AND FACULTY) hereby declare that the work entitled, The effect of seed maturity on germination and subsequent seedling growth of Pongamia pinnata. is my original work. I have not copied from any other students' work or from any other sources with the exception where due reference or acknowledgement is made explicitly in the text, nor has any part of the work been written for me by another person.

25-06-2015
Date submitted

AJEERAH FIRDAUSUL TITNG (35390)
Name of the student (Matric No.)

Supervisor's Declaration:

I, HAMSAWI BIN SAUI (SUPERVISOR'S NAME), hereby certify that the work entitled, The Effect of Seed Maturity on Germination and subsequent Seedling Growth of Pongamia pinnata. (TITLE) was prepared by the aforementioned or above mentioned student, and was submitted to the "FACULTY" as a * partial/full fulfillment for the conferment of Bachelor of Science with Honours (Plant Resources Science and Management. (PLEASE INDICATE THE DEGREE TITLE), and the aforementioned work, to the best of my knowledge, is the said student's work

Received for examination by: _____ Date: 26/6/15
(Name of the supervisor)

I declare this Project/Thesis is classified as (Please tick (√)):

☐ **CONFIDENTIAL** (Contains confidential information under the Official Secret Act 1972)*
☐ **RESTRICTED** (Contains restricted information as specified by the organisation where research was done)*
☑ **OPEN ACCESS**

I declare this Project/Thesis is to be submitted to the Centre for Academic Information Services (CAIS) and uploaded into UNIMAS Institutional Repository (UNIMAS IR) (Please tick (√)):

☑ **YES**
☐ **NO**

Validation of Project/Thesis

I hereby duly affirmed with free consent and willingness declared that this said Project/Thesis shall be placed officially in the Centre for Academic Information Services with the abide interest and rights as follows:

- This Project/Thesis is the sole legal property of Universiti Malaysia Sarawak (UNIMAS).
- The Centre for Academic Information Services has the lawful right to make copies of the Project/Thesis for academic and research purposes only and not for other purposes.
- The Centre for Academic Information Services has the lawful right to digitize the content to be uploaded into Local Content Database.
- The Centre for Academic Information Services has the lawful right to make copies of the Project/Thesis if required for use by other parties for academic purposes or by other Higher Learning Institutes.
- No dispute or any claim shall arise from the student himself / herself neither a third party on this Project/Thesis once it becomes the sole property of UNIMAS.
- This Project/Thesis or any material, data and information related to it shall not be distributed, published or disclosed to any party by the student himself/herself without first obtaining approval from UNIMAS.

Student's signature _____ (Date)

Supervisor's signature: _____ (Date) 25/6/15

Current Address:
KG. PANTAI BAHAGIA KUDAT,
89058, KUDAT SABAH.

Notes: * If the Project/Thesis is **CONFIDENTIAL** or **RESTRICTED**, please attach together as annexure a letter from the organisation with the date of restriction indicated, and the reasons for the confidentiality and restriction.

[The instrument was prepared by The Centre for Academic Information Services]

The Effect of Seed Maturity on Germination and Subsequent Seedling Growth of *Pongamia pinnata* (L.)

Ajeerah Firdausul Titing

(35390)

This project is submitted in partial fulfillment of the requirement for the degree of Bachelor Science with honours

(Plant Resource Science and Management)

Department of Plant Science and Environment Ecology

Faculty of Resource Science and Technology

UNIVERSITY MALAYSIA SARAWAK

2015

APPROVAL SHEET

Name of Candidates: Ajeerah Firdausul Titing

Title: The Effect of Seed Maturity on Germination and Subsequent Seedling Growth of *Pongamia pinnata* (L.)

……..

(Prof Dr Hamsawi Bin Sani)

Supervisor

……..

(Dr Rebicca Edward)

Coordinator of Plant Resource Science and Management Programme

Faculty of Resource Science and Technology

DECLARATION

I am Ajeerah Firdausul Titing third year student from Plant Resource Science and management Programme from the Faculty of Resource Science and Technology hereby declare that all the work done in writing, and producing the report for this project is done by myself under my supervisor Prof Dr Hamsawi Bin Sani until the report is completed

……

(Ajeerah Firdausul Titing) Date:

ACKNOWLEDGEMENT

In the Name of Allah S.W.T., The Most Merciful and The Most Gracious. Praise goes to Allah Almighty for I have been blessed with the strength to finally accomplish my research for Final Year Project.

First of all, I would like to express my sincere gratitude and appreciation to my supervisor Professor Dr. Hamsawi Sani, for his constant guidances, supports, giving advices and suggestions throughout the preparation of this research. To my father Mr. Titing Manawali, my mother Mrs. Sitti Arka Yusop, to my older sister Mrs. Nur Asyikin Titing and my other family members, I render my gratitude and thanks for their constant supports, encouragements and invaluable advices. Heartiest thanks are also to my friends, Qulara Qaora Quentine, Fiona Edward, Freica Miracle James, Pressty Donna Phillip and Nor Aida Binti Mohd Tabir for their constant supports, invaluable advices and lends their hand during the early to final stage of the research. Special thanks to my beloved one, Mohd Yasin Bin Sabihi who always concern with my study and have given me encouragements, invaluable advices and supports to improve myself. Your love has kept me going on.

TABLE OF CONTENTS

LIST OF ABBREVIATIONS

ANOVA- Analysis of Variance

LSD- Least Significant Difference

M_1 – Maturity 1 (green seed)

M_2- Maturity 2 (greenish seed)

M_3- Maturity 3 (brown seed)

GA_3- Gibberellic Acid

IBA- Indol-3-Butyric Acid

P_1- Pretreatment control

P_2 - Pretreatment IBA

P_3- Pretreatment GA_3

T1- M_1P_1

T2- M_1P_2

T3- M_1P_3

T4- M_2P_1

T5- M_2P_2

T6- M_2P_3

T7- M_3P_1

T8- M_3P_2

T9- M_3P_3

TABLE	LIST OF TABLES	PAGE

FIGURE	LIST OF FIGURES	PAGE

The Effect of Seed Maturity on Germination and Subsequent Seedling Growth of *Pongamia pinnata* (L.)

Ajeerah Firdausul Titing

Plant Resource Science and Management
Faculty of Resource Science and Technology
University Malaysia Sarawak

ABSTRACT

Pongamia pinnata or commonly known as Pongam is an economically tree especially as biodiesel, ornamental tree and medical uses. This species has been planted widely because it potentially as to produce biodiesel. Due to its ability as many important functions to human being, many studies were conducted to determine its maturity and germination performance. There are three treatments involve in this study which is three different type of seed maturity: green seed (M_1), greenish-brown seed (M_2) and brown seed (M_3) and also three pretreatments for each different type of seed maturity which is Indol-3-Butyric Acid (IBA) and Gibberellic Acid (GA_3) and control where seeds were soaked without any treatment. The potting media such sand was used to plant all the selected seeds after the seeds were soaked in different growth regulators. The potting media such topsoil and coco peat was mixed to plant the selected seed for growth study. The germination of the seedlings was observed for their length of leaf, width of leaf, height of seedling, stem diameter of seedling and number of leaf. Seeds are treated with GA_3 in M_1 showed better germination percent compared to control and IBA pretreatment. M_3 showed better result in height of seedling, number of leaf, stem diameter of seedling and total leaf area.

Keywords: *Pongamia pinnata*, seed germination test, subsequently growth, growth measurement, cocopeat and top soil

ABSTRAK

Pongamia pinnata atau juga dikenali sebagai Pongam adalah mempunyai banyak kepentingan terutamanya dari segi ekonomi,terutamanya untuk biodiesel, perubatan dan juga sebagai tanaman hiasan. Spesis ini telah ditanam secara meluas kerana penting untuk menghasilkan biodiesel. Oleh kerana keupayaan Pongam dalam banyak kepentingan kepada manusia sejagat, banyak kajian telah dilakukan untuk menentukan kematangan Pongam dan pembesarannya. Tiga jenis rawatan yang berbeza telah dijalankan dalam kajian ini iaitu: biji benih hijau (M_1) , biji benih hijau-coklat (M_2), dan biji benih coklat (M_3), dan juga 3 pra-rawatan dijalankan iaitu melibatkan pra-rawatan pengatur pembesaran iaitu, Indol-3-Butyric Acid (IBA), Gibberellic Acid (GA_3) dan juga pengawal tanpa ada rawatan untuk setiap kematanan biji benih yang berbeza. Media seperti pasir sungai telah digunakan untuk menanam biji benih yang telah dipilih selepas di rendam dalam pra-rawatan. Media seperti tanah dan sabut kelapa telah di campurkan untuk menanam anak-anak pokok yang telah dipilih untuk mengkaji pembesarannya. Percambahan anak-anak pokok telah diperhati iaitu panjang daun, lebar daun, ketinggian anak pokok , diameter batang anak pokok dan bilangan daun. Biji benih yang telah dirawat dengan GA_3 dalam (M_1) didapati menghasilkan peratus percambahan yang tinggi berbanding rawatan pengawal dan rawatan IBA. M_3 menunjukan keputusan yang baik untuk ketinggian anak pokok,,bilangan daun, diameter batang anak pokok, dan luas permukan daun.

Kata kunci: *Pongamia pinnata,* percambahan biji benih, pembesaran selepas percambahan, pengukuran percambahan, sabut kelapa dan tanah

1.0 INTRODUCTION

Francis, Peter & Sudhakara (2008) stated that *Pongamia pinnata* belongs to family Fabaceae formerly known as Leguminoseae. The subfamily of this species is Papilionaceae (Sangwan, Rao & Sharma, 2010). Synonym for *Pongamia pinnata* is *Millettia pinnata. P. pinnata* is commonly known as Indian beech or Pongam in India and also known as Mempari in Malaysia. It is an evergreen tree that can grow up about 15 to 25 m. Pongam seeds usually ripen in February to May (Francis et al., 2008). The seeds of Pongam can easily germinate and fast growing. Due to this character of Pongam, it can grow in areas with ranging rainfall from 500 to 2500 mm and can potentially grow on various type of soil (Csurhes & Hankamer, 2010). It can grow on most soil type ranging from stony to sandy to clayey, including verticals. It does not do well in dry sands. Many systematic studies had been carried out to find the best alternative fuel source from species. One of these species was *Pongamia pinnata* which is one of the most important valuable trees as recent study showed that its seed oil has the potential to be processed as diesel (Goembira & Saka, 2011). *P. pinnata* is the promising one for sustained availability of raw material feedstock for biodiesel production in India" (Meher, Naik, & Das., 2004). Pongam also had been used for medical proposes (Csurhes & Hankamer, 2010). According to Scott et al., 2008, all parts of the plant have been used as crude drug for the treatment of tumors, piles, skin diseases, wounds, ulcers, etc. Pongam is the most important for ornamental landscaping (Scott et al., 2008). In order to raise large scale planting for huge amount of quality seedlings, seeds must be matured so that can overcome the dormancy.

Hence, many countries have planted this species for its value. This study is conducted to evaluate the effect of seed maturity and seed pretreatment on germination.

1.1 PROBLEM STATEMENT

Pongamia pinnata has been identified as one of the most potential tree crops for the production of biodiesel. Due to the seed production problem, many researchers and farmers increase their scale plantation to produce large amount of seedlings. Hence, the type of seeds maturity and growth performance is important factors so that the seedlings will grow faster and will be used for large scale planting.

1.2 OBJECTIVES OF STUDY

The objective of this investigation is to determine the influence of seed pretreatment on seed germination and subsequently seedling growth. The specific objectives are as follow:

a. To evaluate the effect seed maturity of *P. pinnata* on germination
b. To evaluate the effect of seed pretreatment on germination
c. To evaluate the subsequent growth of *P. pinnata* seedlings

2.0 LITERATURE REVIEW

2.1 *Pongamia pinnata*

Family of this species is Fabaceae. The leave is compound, alternate and the flower has white to pink color as shown in Figure 1. *Pongamia pinnata* pods are 4.5 cm long and 1.5-2.5 cm wide, broad, pointed at both ends, yellowish-grey when ripe, and one or two seeded. Seeds are elliptical, compressed, reddish-brown, fairly hard and 2-3 cm long. Sometimes the pods contained one to two seeds, smooth seed and round shape as shown in Figure 2. Seeds weigh is about 1200 g/1000 seeds, with a thin seed coat (Kumar et al., 2007). Each seed weighs about 2g. *P. pinnata* was described as a tree, spreading branch and fast growing tree. It is an evergreen tree, can grow up about 15 to 25 m. According to Kazakoff, Gresshoff & Scott (2011) on the streets of Brisbane, Australia, *Pongamia pinnata* as a mature tree growing as ornamental trees. During mid-november, the Pongam will start flowering. After harvesting of *pongamia pinnata*, the oil from seeds can be extracted by cold pressing and used to produce diesel.

Figure 1. (a). Tree of *Pongamia pinnata*.
(b). leaf of *Pongamia pinnta*, .
(c). flower of *P.pinnata*

Figure 2. (a) Fruit of *P.pinnata* with different colour
(b). Different maturity of *P.pinnata*.
(c). Double seeds found in one pod of fruit.
(d).Seed size of *P.pinnata*

2.2 Economic Importance of *Pongamia pinnata*

A recent study by Jiang et al., (2012), *"Pongamia pinnata* is regarded as a sustainable biofuel feedstock of the future because of its abundant production oil rich seeds, tolerant to abiotic stress and ability to undergo biological nitrogen fixation (minimizing nitrogen inputs)". *P. pinnata* has various type of uses such as medicine, the seeds can produce biodiesel and as ornamental tree. Hence, many countries planted this species for its value. Goembira & Saka (2011) *P.pinnata* has the potential to be processed as diesel engine fuel. Pongam oil is the most sought after biofuel in India (Hosalli et al., 2013). *P.pinnata* have the potential to produce quality diesel (Csurhes & Hankamer, 2010), and as a sustainable feedstock biofuel production (Kazakoff et al., 2011). As the importance of biofuel production start to impact the energy economies of the world and this new industry will rely on the reliable supply of feedstock from sustainable fuel crops. *Pongamia pinnata* usually contain 35 to 45% (w/v) fatty acids and triglycerides which called oil, but not all oil can be extracted by mechanical cold pressing and also easily converted to biodiesel by transesterification (Kazakoff et al., 2011). Major tropical and subtropical agricultural production zone of the world *Pongamia pinnata* has attributes that place in suitable condition for adoption as a future feedstock for biodiesel production. As reported by (Scott et al., 2008), *Pongamia pinnata* have many uses in traditional medicines in India and other countries. All parts of the plant have been used as crude drug for the treatment of tumors, piles, skin diseases, wounds, ulcers, etc. Extracts of the plant possess significant anti-diarrhoeal, anti-fungal, anti-plasmodial, anti-ulcerogenic, anti-inflammatory, analgesic activities. According to Yaday et al., (2011), the roots of *Pongamia pinnata* are good for cleaning foul ulcers, cleaning teeth, strengthening gums and gonorrhea. The fresh bark of *Pongamia pinnata* is sweet and mucilaginous to taste, soon become bitter

and acrid. Leave of *Pongamia pinnata* are digestive, laxative, antihelmintic and are good for diarrhea and cough. Flowers are useful to quench dipsia in diabetes. The seeds are antihelmintic, bitter and acrid. They are useful in inflammation, chronic fevers, anaemia and hemorrhoids (Yaday et al., 2011). According to Arote & Yeole (2010) Pongam is used as medicinal purpose especially in India. India usually has long tradition of *P.pinnata* being used as a medical plant, particularly with the Ayurvedha and Siddha medicine systems of India. *P.pinnata* also as a source of biomedicines has been reported, especially as an antimicrobial agent and as a therapeutic agent (Muthu et al., 2006). Pongam is important for ornamental landscaping (Scott et al., 2008). The *Pongamia pinnata* tree is being cultivated in a large number of gardens and along the countless roads in India and is becoming the one of the most admired city trees (Duke, 1985).

2.3 Seed maturation of *Pongamia pinnata*

Seed maturation of *Pongamia pinnata* takes about 10 months. Srimathi et al., (2013) the pod colour was light green from first week and at fifteenth week the colour changed to dark green from 16^{th} week to 20^{th} week, while the colour was greenish brown in 21^{st} and 22^{nd} week, and changed to yellowish brown in 23^{rd} and 24^{th} weeks and lastly changed to light brown in 25^{th} and 26^{th} week after anthesis. Other studies from north India Stated that *P.pinnata* needs 327-344 days after the anthesis and has genetic variation in duration of seed and pod maturation, seed size, pod colour and other morpholody characteristics (Srimathi et al., 2013). Fruit and seed of *Pongamia pinnata* are easy to identify based on their colour which is fruit colour from light green to brown. When the fruit is matured it dropped from tree to the ground due to formation of abscission layer. The study by Srimathi et al., (2013) the highest germination of 96% was recorded for seeds of light brown other than green and dark brown seed.

2.4 Seed germination

Seed germination required many factors such as proper temperature, the presence of adequate water, and ability to overcome dormancy. There are four major factors that affect seed germination such moisture, air, temperature and light. The treatments also are important in order to germinate seeds. There are two type of seed germination which is epigeal and hypogeal germination. The seed structure will have the different types of growth from different type of plant. *Pongamia pinnata* shows epigeal germination which means the cotyledon was brings upwards to above the ground. Kesari & Rangan (2010) the seedling of *Pongamia pinnata* attain a height of 25-30 cm in their first growing season and transplanting to the field occurs at the onset of rainy season when seedlings are 60 cm in height. The various treatments in seeds show different time in seed germination of the seed due to different physiological maturity and dormancy of the seed. Germination of *P.pinnata* takes almost a week and up to 80% seed germinates in better management in nursery. However the knowledge is important for study of germination and pretreatment is essential for reproducibility of uniform result. Usually, pretreatment commonly used are soaking of seed in hot water, in growth regulators or in salt solution Kesari & Rangan (2010). Soaking the seeds in pretreatment also increase the germination percentage of seed. The hot water treatment, mechanical and chemical scarification had helped in breaking seed dormancy (Kumar et al., 2007). Beside, *P.pinnata* tree can grow on unproductive land and is adaptable to wide agro-climate conditions. Growth of *P.pinnata* is rapid and potentially reaching adult height in 4-5 year and producing seeds in 4-7 year (Duke, 1985). In addition, the seeds production of *P.pinnata* is prolific with a single tree yielding 9-90 kg seeds per annum.

Besides, techniques for growth *P.pinnata* is not only limited to germinating seed, but also through vegetative propagation. Vegetative propagation is a method of producing identical plants which is identical in genotype with the mother plant. One of the advantage in vegetative propagation is that by this techniques the plant can produce the plant stock in a short period of time as compared to those raised by seeds (Kesari & Rangan, 2010). Vegetative technique is important in cross pollinated species like *P.pinnata* because through this technique the true to type plants are produced with shorter juvenile period and also produce early productivity. *Pongamia pinnata* also has been successfully propagated through cutting. Kesari & Rangan (2010) *P.pinnata* can potentially be propagated through semi-hard wood and by hard wood.

2.5 Potting Media

Potting media also known as potting mix or potting compost which is a medium for plant growth in nursery. Potting media such topsoil and coco peat are commonly used. Topsoil and coco peat are commonly used as potting media to study growth. Initially, the potting media is sterilized to prevent infection of weeds and diseases. According to Miller & Jones (1995) growing media used in container nurseries are available in two basic forms namely soil based and organic based. In soil based content, the major component is soil while organic based constituted organic material such compost, peat, coconut coir, or organic materials for promote better root development. The potting media or grow media served many functions including for physical support, water supply, aeration and supply of mineral nutrient.

On the other hand, the growing media also contain pathogenic bacteria and fungi. Organic ingredients are important in potting media. Common organic ingredients include compost, coco peat, sawdust, peat moss and other organic materials. Organic ingredients are

lightweight, have high holding capacity, and CEC. Inorganic ingredients usually added in growing media to support and maintain a structural system and also improved aeration and drainage. Inorganic material a very low CEC (Cation Exchange Capacity) and also provide a chemically inert base for the growing medium. The example for inorganic ingredients commonly used are sand, vermiculite, pumice and polystyrene beads.

Usually, fine river sand was used for germination seeds as shown in Figure 5. Coco peat and topsoil also was used for growth of plants as shown in Figure 3. Coco peat has many functional qualities which is high water holding capacity, better drainage, absence of weeds, pathogen and fungi, slow decomposition, easy wettability, CEC, and electrical conductivity.

Figure 3. Coco peat and Top soil

Figure 4. Pots Contain Media (1: 2 v/v)

Figure 5. Germination test

Figure 6. Subsequently growth of *Pongamia pinnata*

2.6 Plant Growth Regulator

Usually, plant growth regulator such IBA and GA_3 was used to enhance seed germination. Gibberellic Acid (GA_3) is a hormone found in plants to promote growth and elongation of cell. According to John (2012) many effects of GA_3 on plant growth are overcoming dormancy, premature flowering, increase fruit set, increase growth, and root formation. GA_3 treatment can enhance seeds germination and effective to overcome dormancy if treatment of seed with high concentration of GA_3. Indol-3-Butyric Acid (IBA) is the plant hormone in the auxin that important in plant growth and development. The function of IBA commonly used auxin for root formation. IBA also can enhance seed germination.